

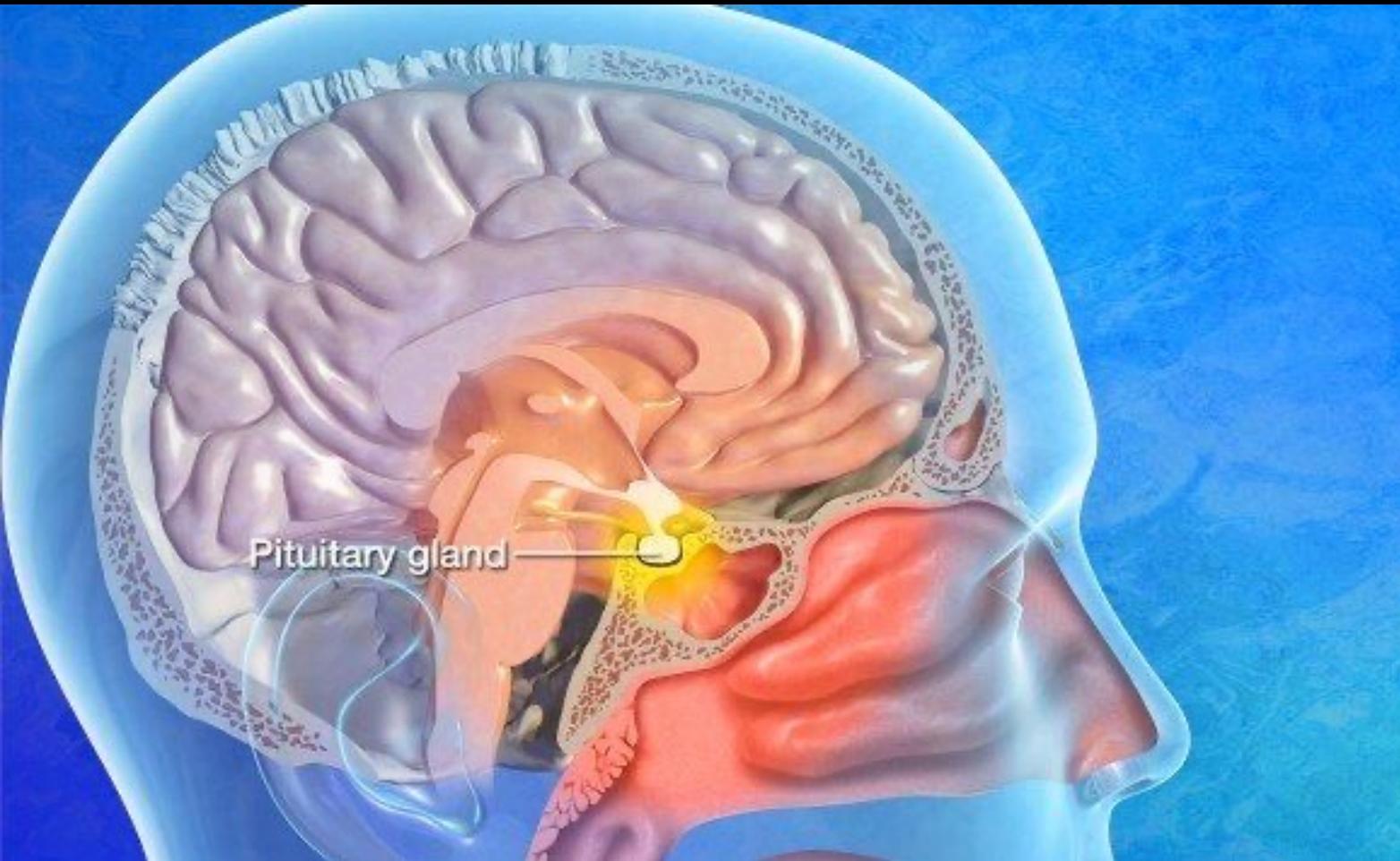
# *WHAT YOU NEED TO KNOW ABOUT PITUITARY SURGERY.....*

*Anesthesia Update 2023*

*Minh Hai Tran Neuroanesthesia Dept, UCSD*



# *Your Case.....*



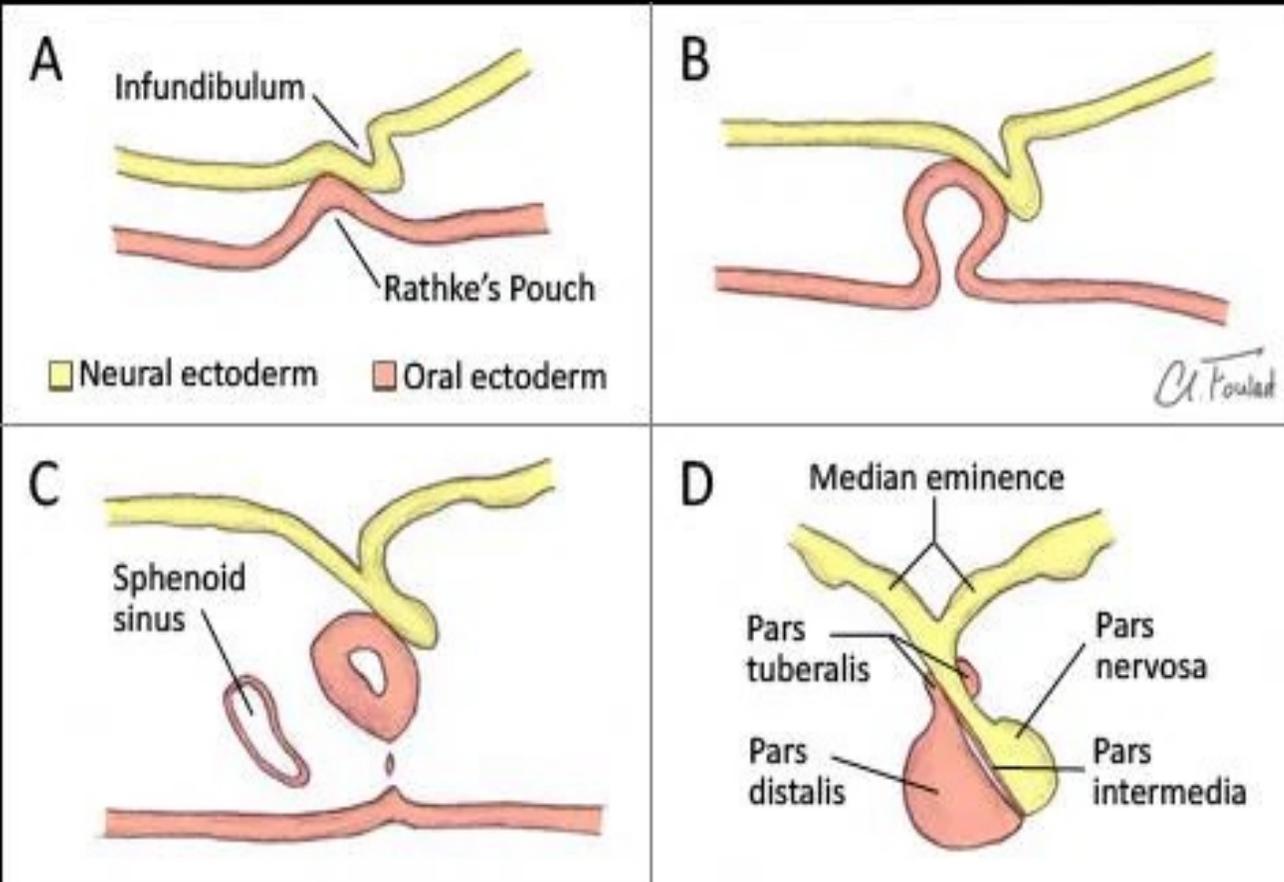
- 38 M
- BMI 45 , Ht 6''7' , Wt 180kg
- DM2, HT, OSA, Migraines
- Bitemporal hemianopia, severe headaches
- s/f Endoscopic endonasal transsphenoidal surgery for removal of a pituitary lesion



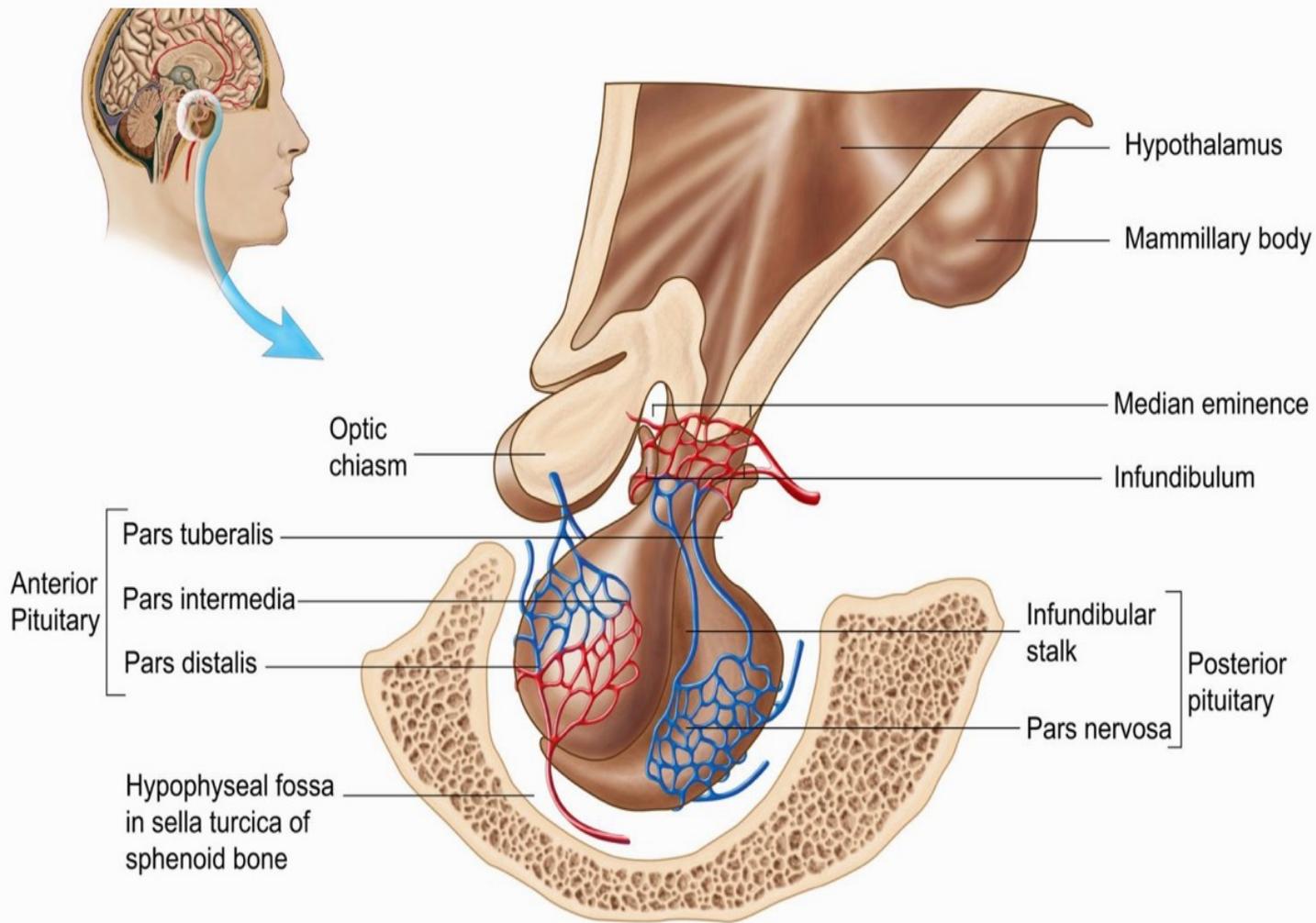
# *How do you prepare for this case?*

- What type of pituitary mass is it? Is this a secreting or non secreting pituitary mass?
- What are the current neurological deficits?
- Look at the imaging
- How do I set up this case?
- Will they be using neuromonitoring?
- What complications should I be prepared for?

# Embryology of the Pituitary Gland



- Consists of both neural tissue and mucosal tissue.



# *Anatomy of the Pituitary Gland*

- Pea sized 0.5-1.0 g, <1cm
- Anterior glandular adenohypophysis 80%
- Infundibulum
- Posterior hypophysis
- Hypophyseal portal circulation

## TYPES OF PITUITARY MASSES

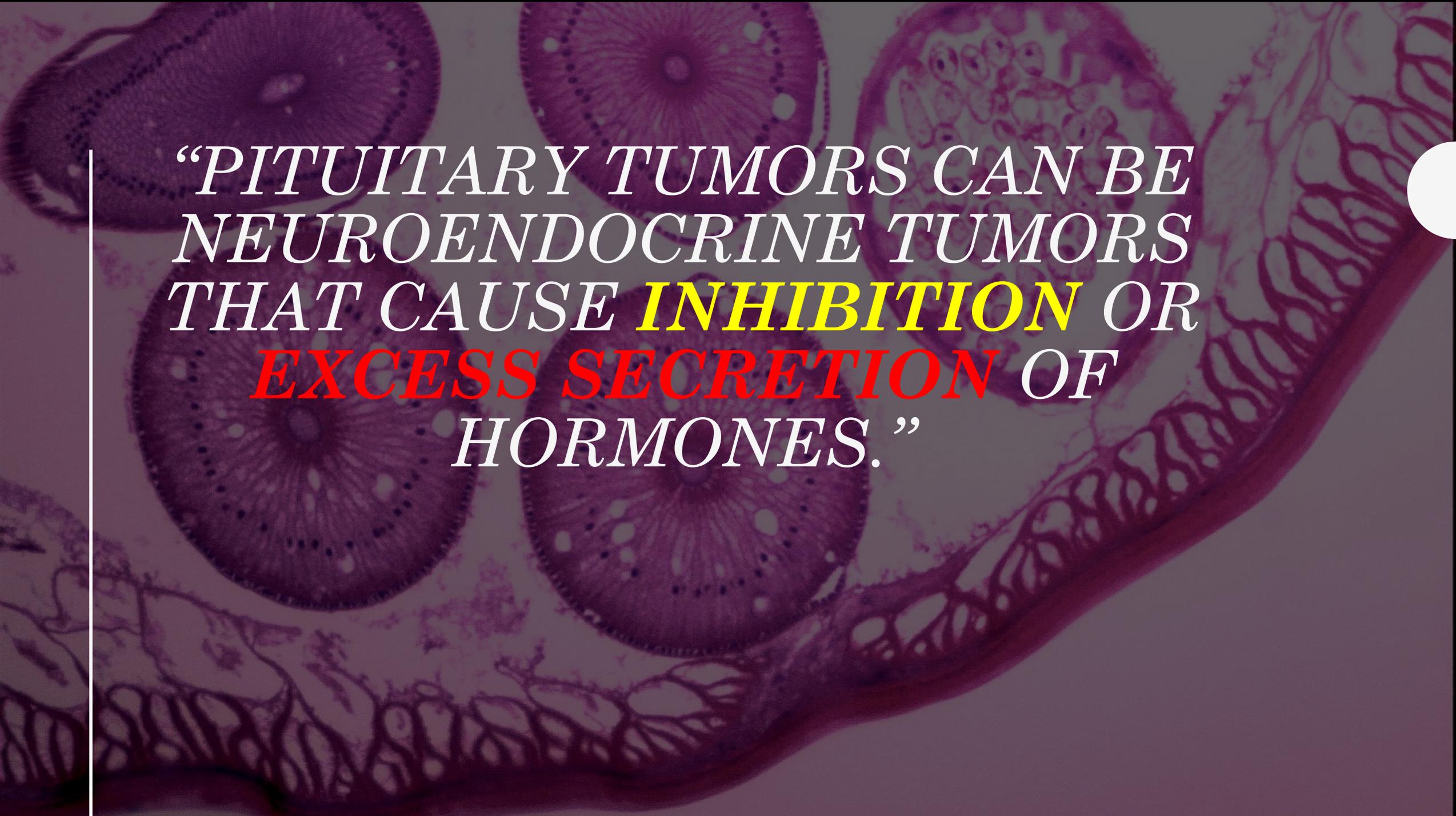
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- PITUITARY ADENOMAS* \*
- RATHKE'S CLEFT CYSTS*
- SELECTED PARASELLAR MENINGIOMAS*
- CRANIOPHARYNGIOMAS*
- CLIVAL CHORDOMAS*

# Pituitary Adenomas

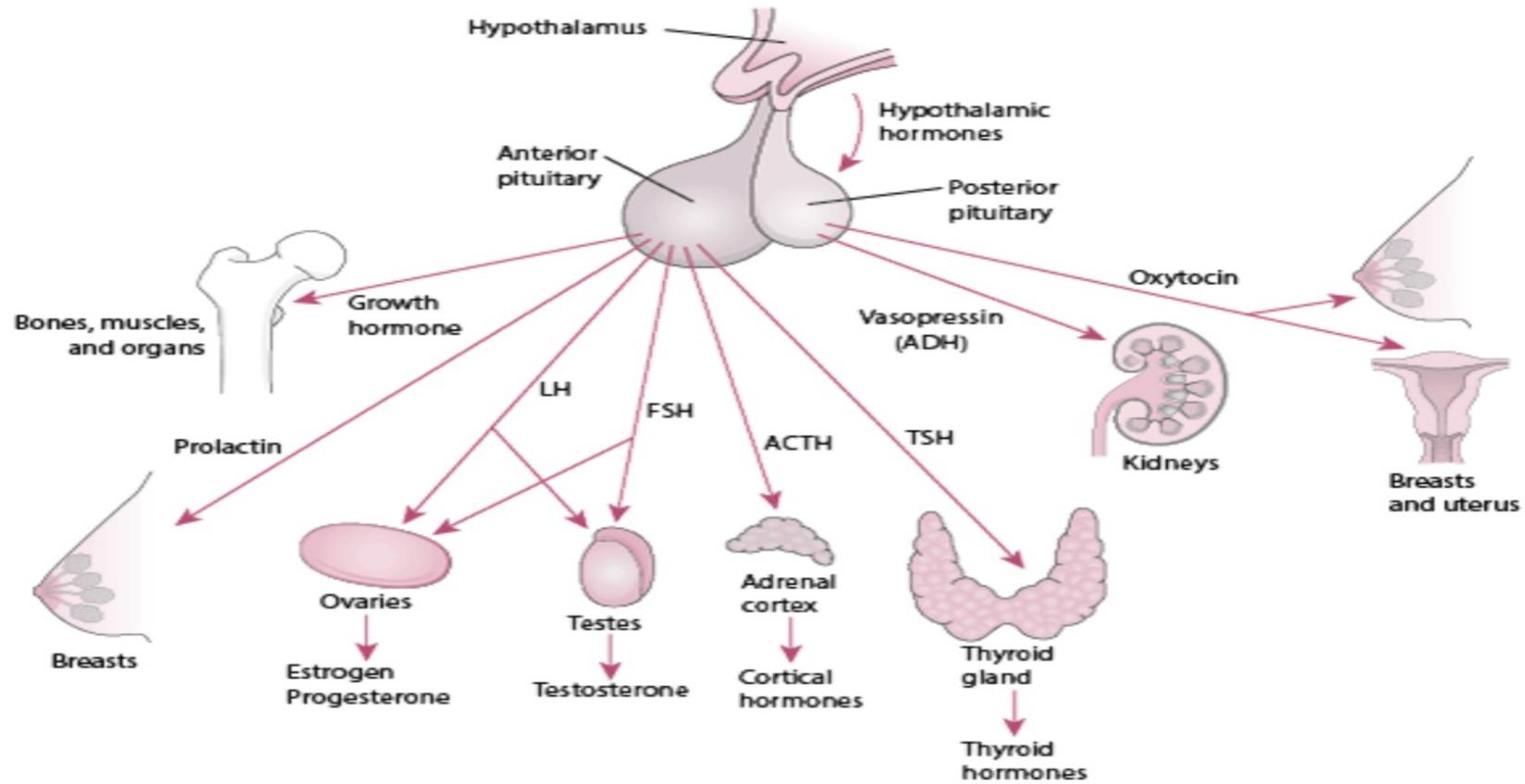
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- 25% Non-Secretory
  - Function lost in decreasing order FSH/LH → GH, ACTH → TSH
- 75% Secretory
  - Most to least common PRL (50%) → GH (20%) → ACTH (20%) → Mixed (10%)

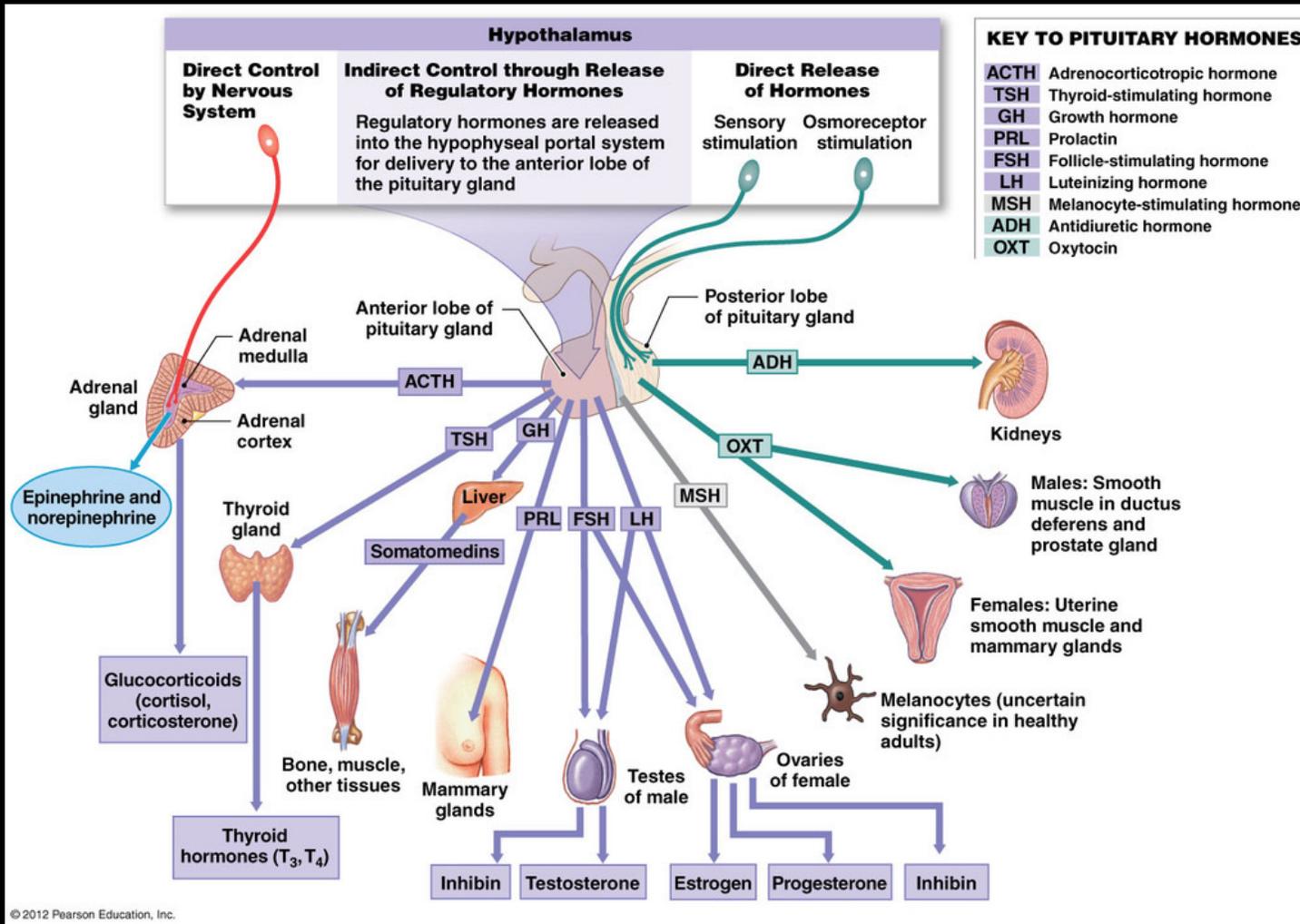
A microscopic image of brain tissue, likely showing the hypothalamus and pituitary gland, with a purple overlay. The image shows various cellular structures and patterns, including what appears to be the infundibular stalk and the pituitary gland. The text is overlaid on the image.

*“PITUITARY TUMORS CAN BE  
NEUROENDOCRINE TUMORS  
THAT CAUSE **INHIBITION** OR  
**EXCESS SECRETION** OF  
HORMONES.”*

# The Pituitary and Its Target Organs



# Lab Tests



- TSH
- PRL
- FSH, LH
- ACTH
- IGF-1
- Oral Glucose Tolerance Test with GH.

# *Anesthesia Concerns*

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## Excess Hormone

- Cushing's Disease  
(↑ACTH leading to ↑Cortisol)
- Acromegaly  
(↑GH leading to ↑IGF-1)

## Lack of Hormone

- Hypothyroidism  
(↓TSH leading to ↓Thyroxine)
- Central Diabetes insipidus  
(↓ADH or vasopressin)

# Hormonal Syndromes – Cushing's Disease

-↑ACTH from anterior pituitary leading to raised cortisol

-Treated with medication, radiation +/-surgery.

## Medications

1. Block adrenal synthesis (Ketoconazole)
2. Glucocorticoid Receptor antagonists (Mifepristone)
3. Block ACTH secretion (Dopamine agonists-  
Bromocriptine)

## Cushing Syndrome

Due to **excess cortisol-like medication** (prednisone) or **tumor** that produces or results in production of **excessive cortisol**  
[Cases due to a **pituitary adenoma = Cushing disease**]



# Anesthesia Considerations – Cushings Disease

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## Central obesity

- Buffalo hump and moon facies may increase difficulty with airway management

## OSA

- Likely related to obesity, but also with myopathy of airway muscles

## Cardiovascular

- Hypertension, dyslipidemia, increased risk of MI, stroke, and thromboembolism
- Preoperative blockade of mineralocorticoid activity with spironolactone may help Rx HTN

## Endocrine

- Glucose intolerance

## Renal

- Electrolyte abnormalities



**Figure 1: Cushing maintained an intense interest in pituitary surgery throughout his career. In these rare photos of Cushing with a patient, he demonstrates the features of acromegaly (Courtesy of the Cushing Brain Tumor Registry at Yale University).**

## *Hormonal Syndromes – Acromegaly*

- ↑GH from anterior pituitary leading to raised IGF-1
- Treated with medication, radiation +/- surgery.

### Medications

1. Dopamine Agonist. (Bromocriptine)
2. Dopamine precursor (L-DOPA)

# *Acromegaly & the Difficult Airway*

- Mandibular and maxillary enlargement
- Macroglossia
- Prognathism
- Swelling of soft palate and pharyngeal wall
- Thickening of true and false vocal cords
- Vocal cord paresis
- Tracheal compression
- Hypertrophy of epiglottis and peri-epiglottic tissues





# *Acromegaly & the Difficult Airway*

- Reported incidence of difficult intubation varies between 9-40% compared to 2-6% in patients without acromegaly
- Soft tissue changes associated with acromegaly MAY be reversible with medical management
- Bony changes are irreversible; regression of soft tissue changes does not guarantee easier airway management
- Patients without hoarseness or dyspnea and overall favorable airway exam are typically approached in a routine manner
- **If airway difficulties are suspected, it is always prudent to secure the airway by awake techniques**

# Anesthesia Considerations - Acromegaly

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## Cardiovascular

- Hypertension, LV hypertrophy, arrhythmias, cardiomyopathy (depressed EF)
- Preoperative cardiac testing and intraoperative monitoring should be based on preoperative signs and symptoms

## Obstructive sleep apnea (OSA)

- OSA occurs in up to 50% of patients with acromegaly
- More sensitive to respiratory depressant effects of sedative and opioids
- Use of CPAP/BPAP post-operatively should be discussed with surgeon
- Positive pressure increases risk and pneumocephalus and meningitis

## Diabetes Mellitus

- Occurs in up to 15% of patients with acromegaly

## Difficult Access

- Thick skin and connective tissue. Consider having ultrasound available.

# *LOOK AT MEDICATIONS*

*Are they on replacement therapy?*

*Thyroxine*

*Steroids*

*Are they on suppressive therapy?*

*Bromocriptine*

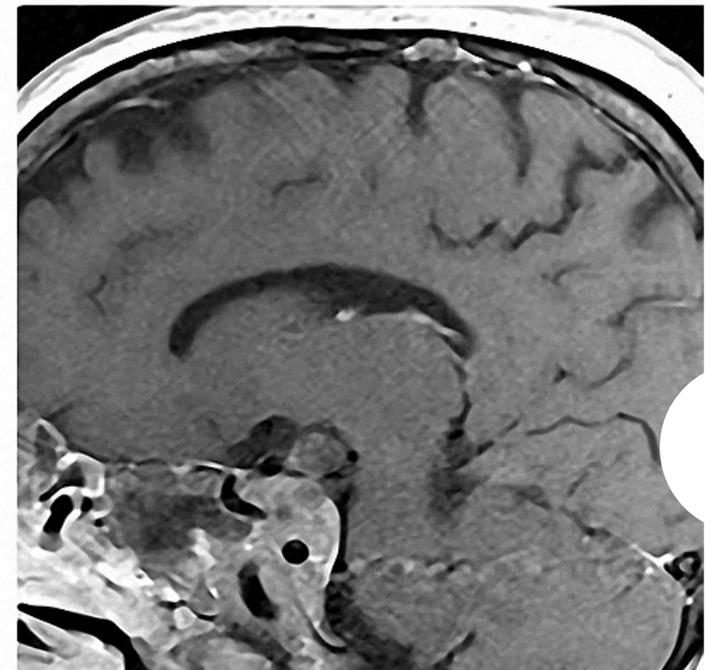
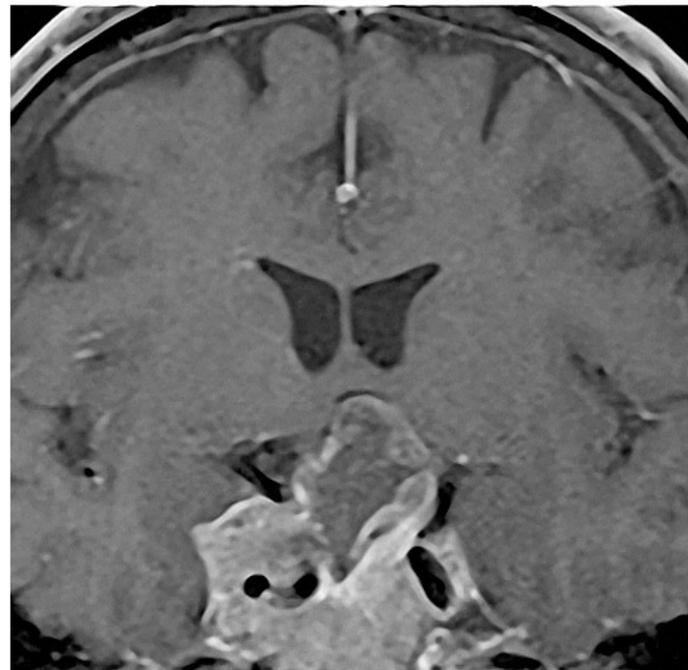
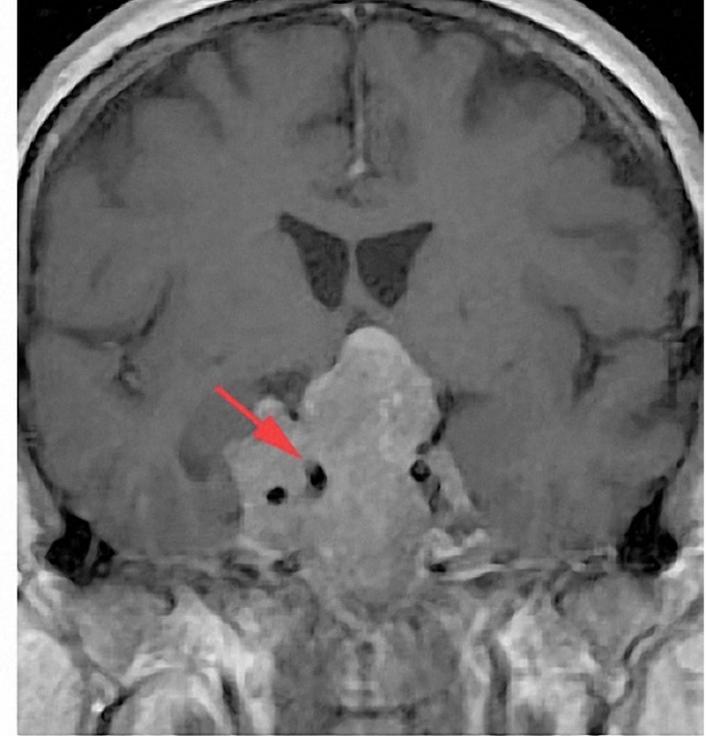
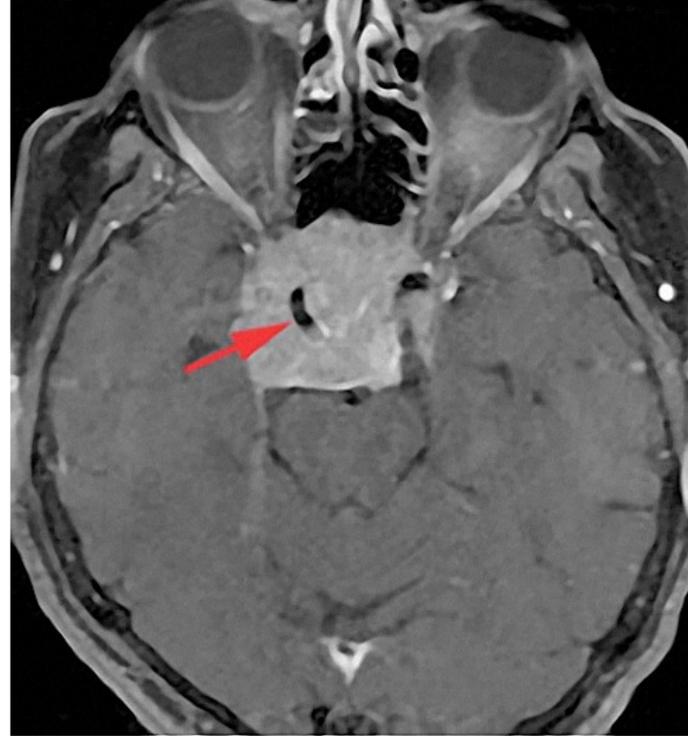
*Ketoconazole*

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# *LOOK AT THE IMAGING*

- 1. Size?*
- 2. Extension past the sella?*
- 3. Compression of nearby structures*
- 4. Are vascular structures at risk*



# Surrounding Structures

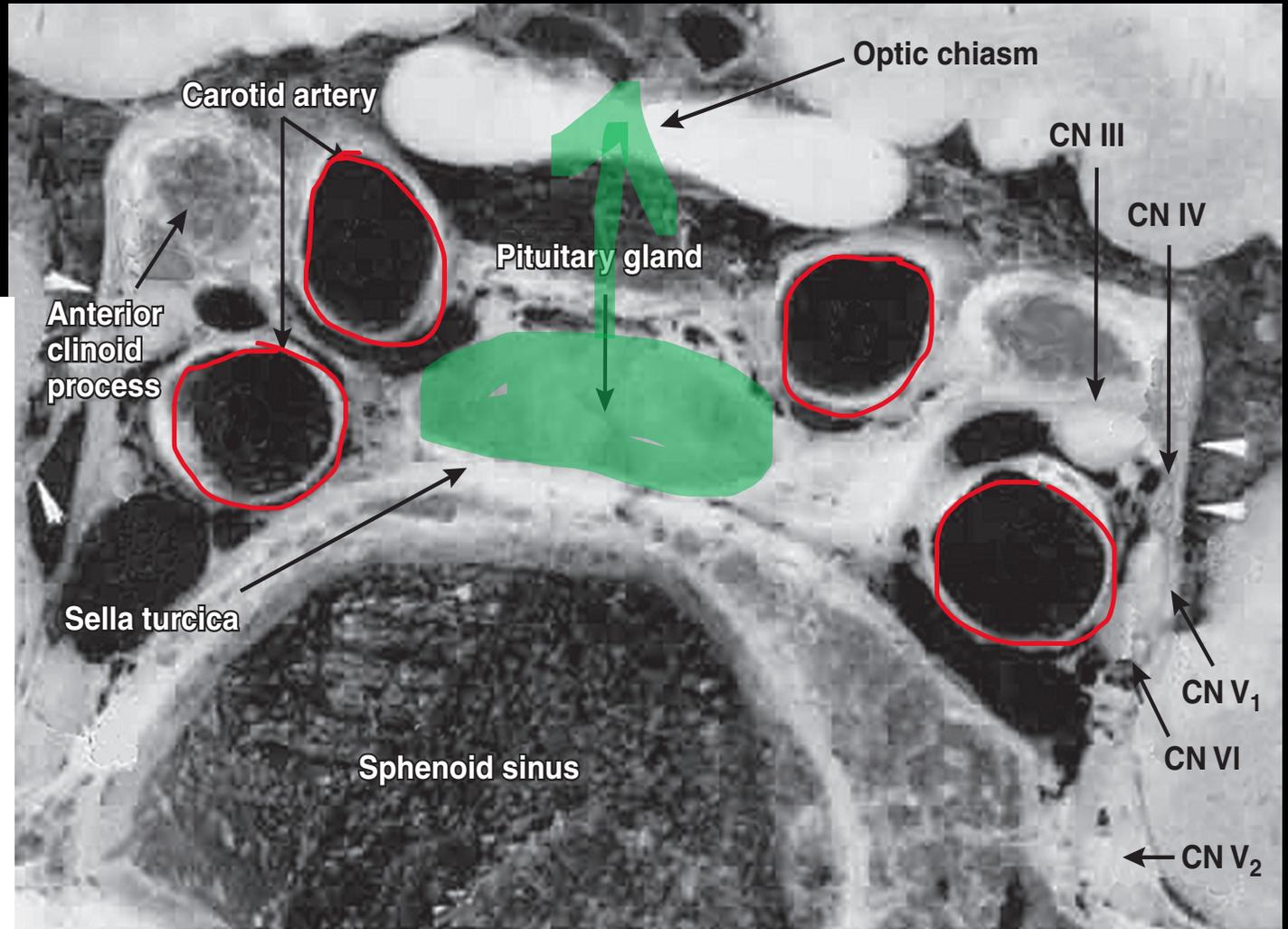
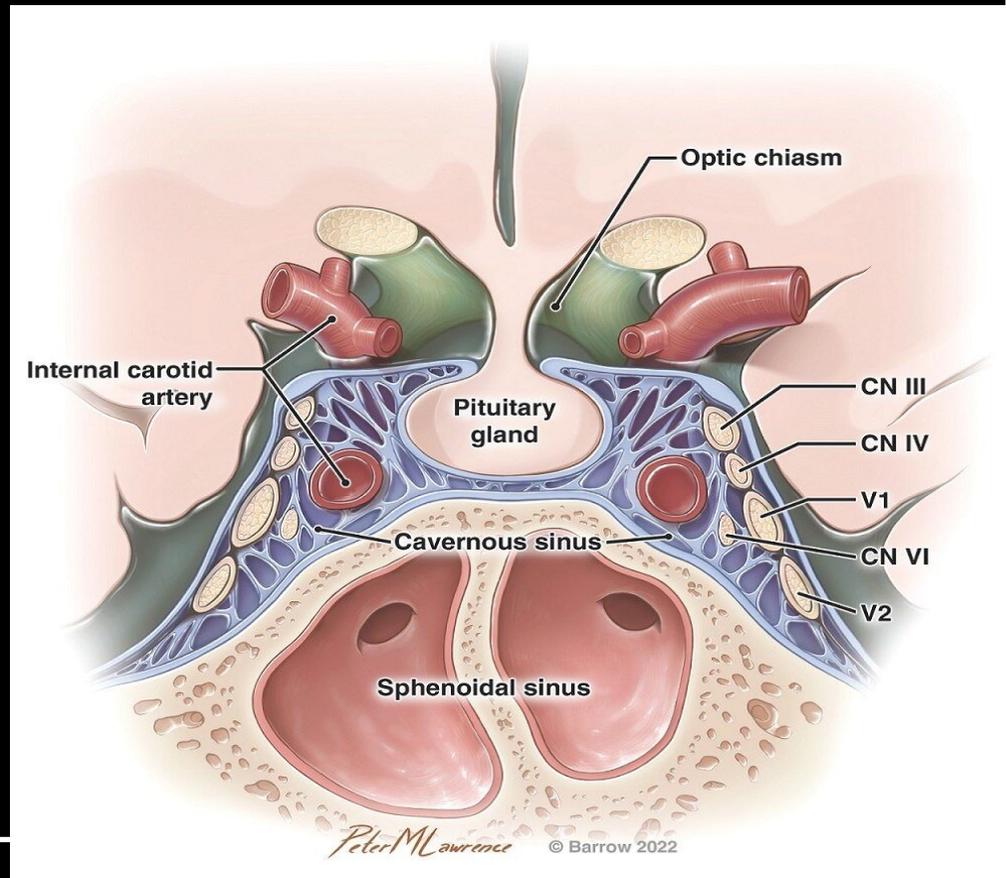


Fig 19.1 Cottrell & Patel Neuroanesthesia (inpress) 2023. Adapted from *Anaesthesia for Patients with Endocrine Disease* edited by James (2010)

# Surgical Approaches.

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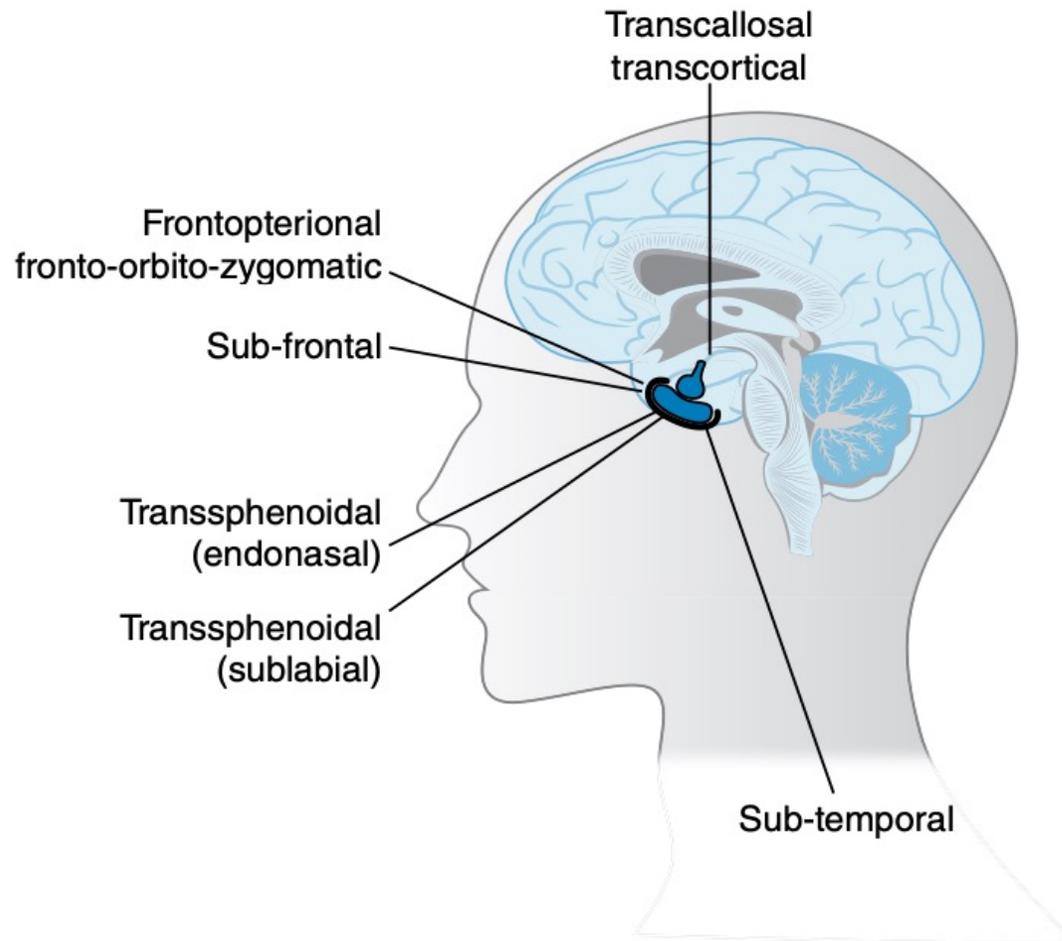


Fig 19.4 Cottrell & Patel  
Neuroanesthesia  
(inpress). 2023

# *Endoscopic techniques vs open techniques*

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- **Endoscopic Endonasal Transsphenoidal**

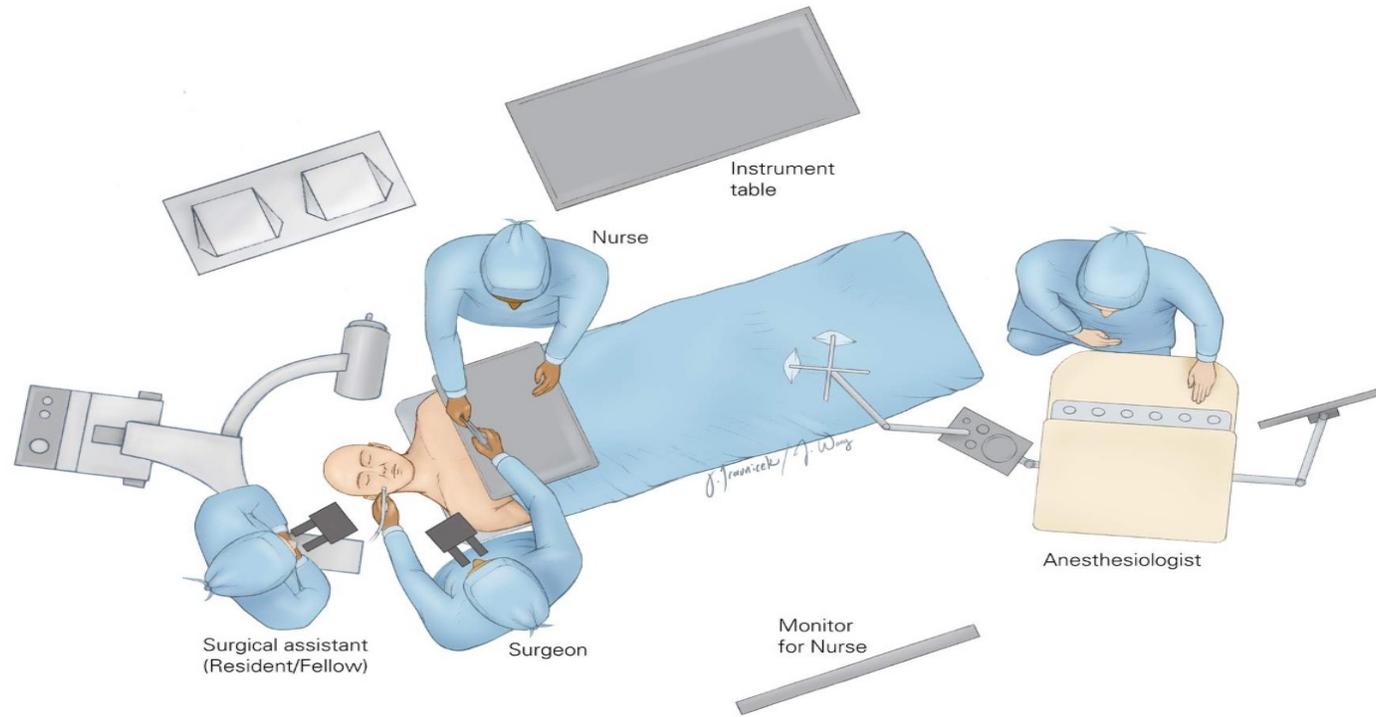
- Masses confined to the paramedian sellar and suprasellar territories medial to the carotid arteries and inferior to the subchiasmatic space
- Vertical growth not a contraindication

- **Sublabial Transsphenoidal**

- Surgical preferences

- **Open Craniotomy** (Subfrontal, Frontopterional, Transcallosal/Transcortical, Subtemporal)

- sphenoid sinusitis
- intrasellar vascular anomalies, ectatic midline carotid arteries,
- significant lateral suprasellar extension of tumor, especially when the epicenter is lateral to the carotid artery



<https://www.neurosurgicalatlas.com/volumes/cranial-approaches/transnasal-transsphenoidal-approaches/microscope-guided-endonasal-transsphenoidal-approach>

# *OPERATING ROOM SET UP FOR TRANSSPHEROIDAL ENDOSCOPIC SURGERY*

# *Anesthesia Management*

- Standard ASA Monitors
- GETA
- 2x PIV: one in upper extremity, one in lower extremity
- Post-induction arterial line
- Foley Catheter for urine output monitoring (i.e risk of DI) and length of the case. Temperature monitoring if available.
- Type & Screen



## Preparation

# *Anesthesia Management*

- **Anxiolytics**
  - Preferable avoid if possible unless extremely high anxiety
  - Caution in patients at risk of respiratory depression
- Discuss with surgeon **Dexamethasone**
  - Can inhibit HPA axis over 24hrs
  - May give a false diagnosis of pituitary insufficiency which some surgeons use as a marker for successful tumor resection.



**Preop**

# Anesthesia Management

- **ICP** are usually not an issue (slow growing tumor)
- UCSD surgeons prefer **neuromonitoring** so we use TIVA +/- 0.5 MAC, usually no neuromuscular blockade after induction.
- The majority of the surgery is not painful but anticipate **elevated hemodynamics** with nasal injection of LA with Epinephrine, and during the intranasal approach, drilling of the sphenoid bone
- Surgeons may ask for lower BP's to facilitate their view



**Intraop**



- Taping Methods
  - LEAVE VERMILLION BORDER FREE
  - ETT Midline
  - (Bilateral bite blocks for facial symmetry)
- Patient positioning in low reclined beach chair
- +/- Pins vs headrest

# *Anesthesia Management*

- Oral gastric tube before extubation.
- (Our surgeons don't use a throat pack)
- Important to remind surgeons to let you know approximate time to surgical completion – no closure just packing the nose with fat.



**Emergence**

# *Anesthesia Management*

- **Smooth emergence.**
  - AVOID COUGHING, VOMITING, STRAINING
  - AVOID HYPERTENSION



- ↑CVP can increase bleeding
- ↑ICP can exacerbate CSF leak
- Coughing and bucking can force nasopharyngeal flora into the wound leading to meningitis

# *Anesthesia Management*

- **AVOID POSITIVE  
PRESSURE VENTILATION  
POST EXTUBATION!!!.**





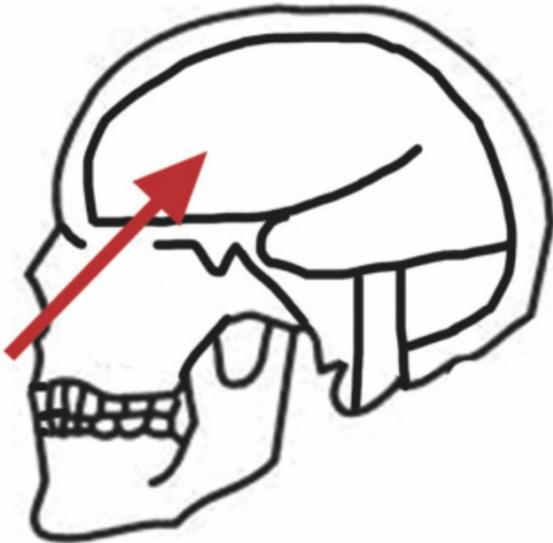
Case Report

## Tension Pneumocephalus from Positive Pressure Ventilation Following Endoscopic Skull Base Surgery: Case Series and an Institutional Protocol for the Management of Postoperative Respiratory Distress

Mendel Castle-Kirsbaum<sup>1</sup>, Yi Yuen Wang<sup>2</sup>, James King<sup>3</sup>, Brent Uren<sup>4</sup>, Martin Kim<sup>5</sup>, R. Andrew Danks<sup>1,6</sup>, Tony Goldschlager<sup>1,6</sup>

# AVOID

## Bag Mask Ventilation



- Background: Tension pneumocephalus (TP) is a rare but feared complication of endoscopic endonasal skull base surgery. In contrast to simple pneumocephalus, which is common after endoscopic transnasal approaches and managed conservatively, TP represents a neurosurgical emergency and mandates urgent decompression.
- Case description: Here we present 2 cases of TP as a consequence of positive pressure ventilation following endoscopic endonasal skull base surgery. Both occurred during resuscitation for postoperative hypoxia. These cases prompted the development of an institution-wide protocol to identify and manage patients at risk of TP after extended skull base approaches.
- Conclusions: To our knowledge, these are the only such cases of postoperative TP following positive pressure ventilation in the literature.



Asystole, Bradycardia

CSF Leak, Meningitis

Adrenal suppression, Panhypopituitarism

Bleeding (extracranial/intracranial) - arterial and cavernous sinus bleeding

Pneumocephalus

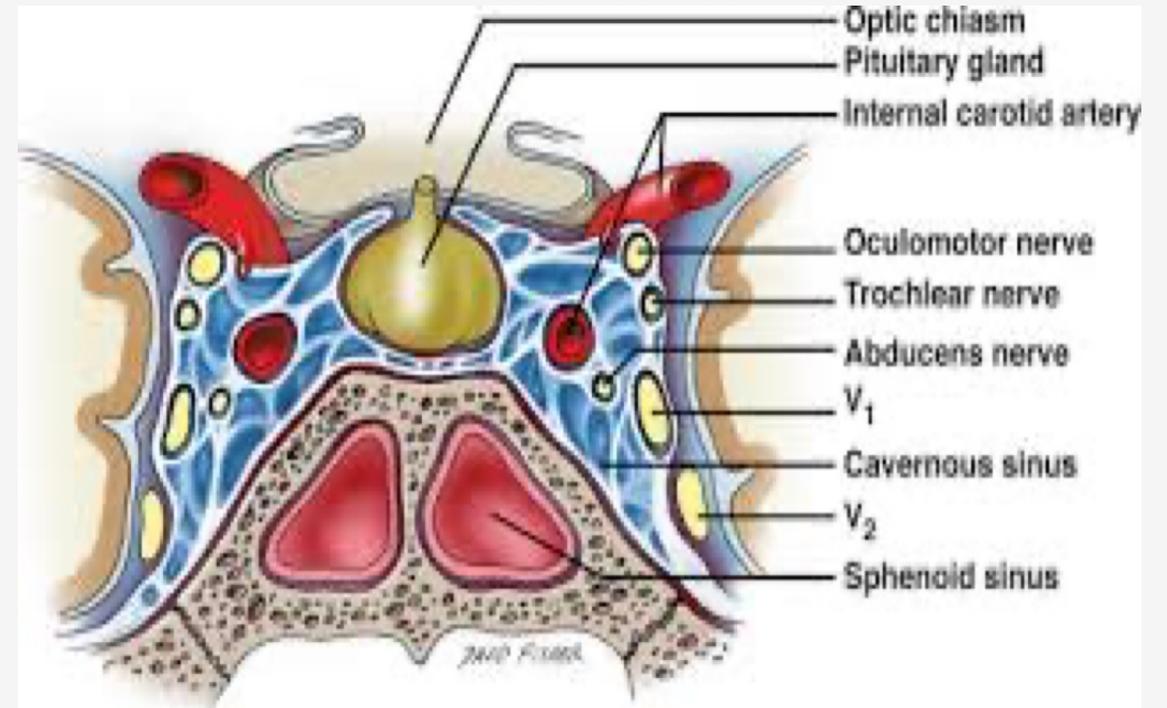
ICA occlusions and nerve compression of CN 3, 4, 5, 6 with nasal packing

Aspiration

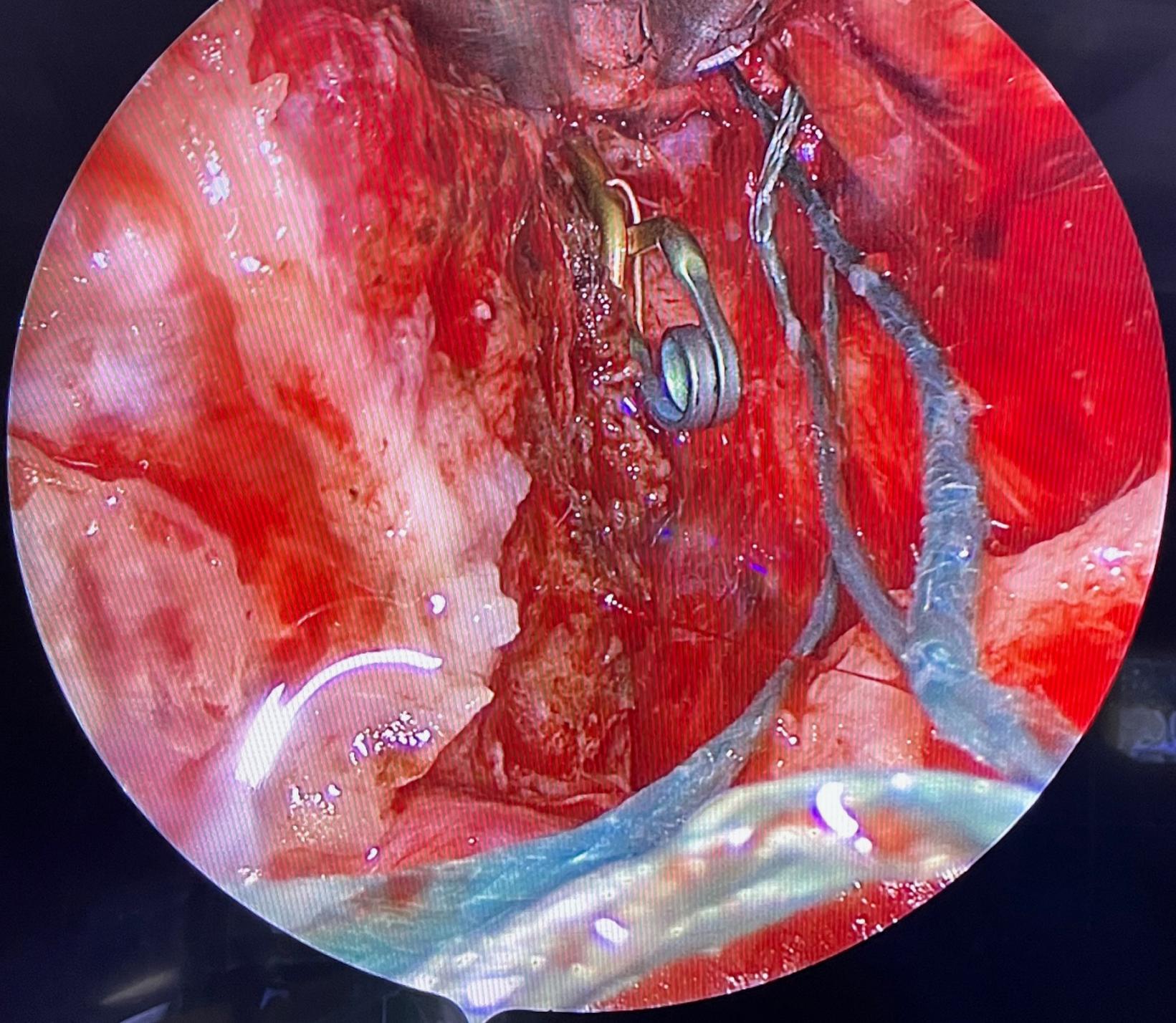
Vision loss

Diabetes insipidus

SIADH



# *Complications*



**Table 19.2. Differential Diagnosis of, Diabetes Insipidus, Syndrome of Inappropriate Antidiuretic Hormone and Cerebral Salt Wasting.**

	<b>DI</b>	<b>SIADH</b>	<b>CSW</b>
<b>Volume status</b>	hypovolemia	normo- or hypervolemia	hypovolemia
<b>Urine output</b>	increased	low to normal	increased
<b>Serum sodium</b>	increased	decreased	decreased
<b>Urine Sodium</b>	decreased	increased	increased
<b>Serum osmolality</b>	increased	decreased	decreased
<b>Urine osmolality</b>	decreased	increased	increased

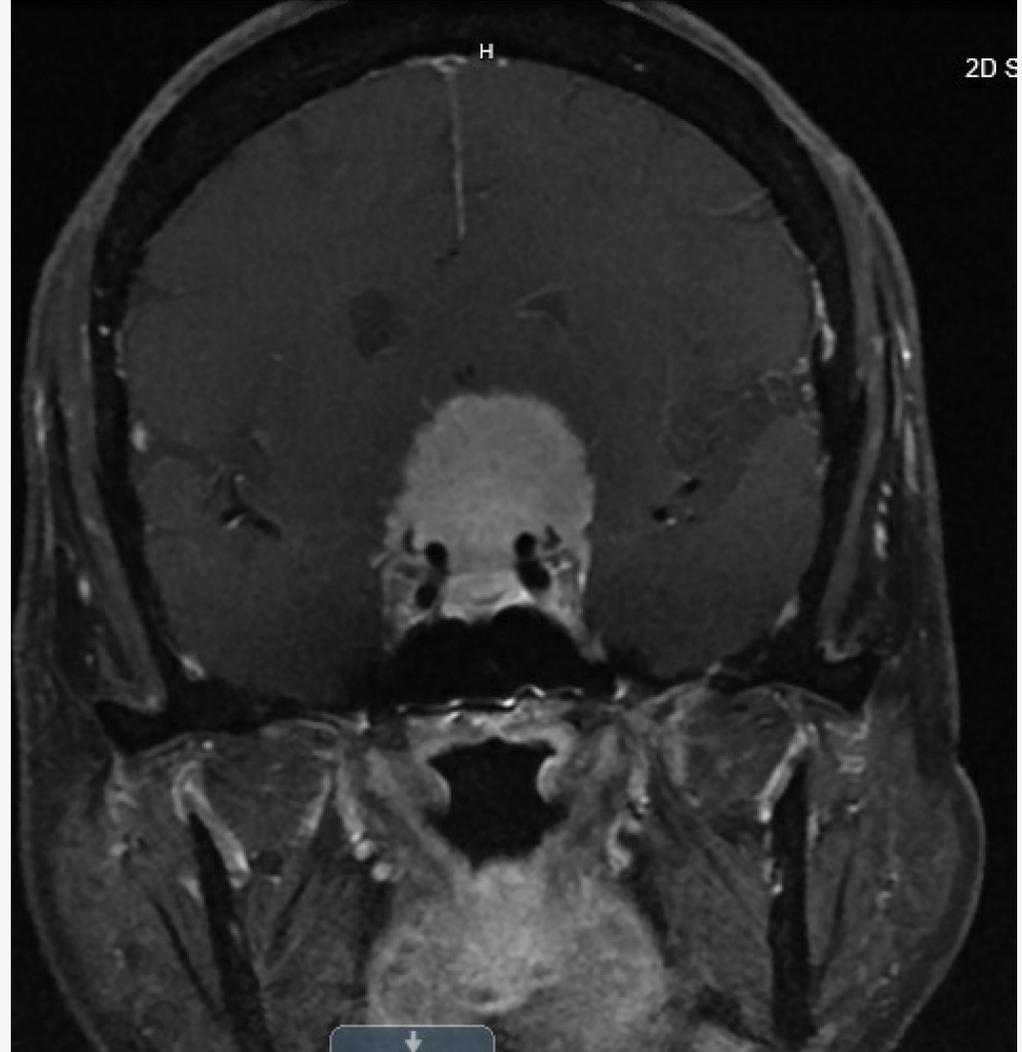
Table 19.2.

Differential Diagnosis of Diabetes Insipidus (DI), Syndrome of Inappropriate Antidiuretic Hormone (SIADH) and Cerebral Salt Wasting (CSW).

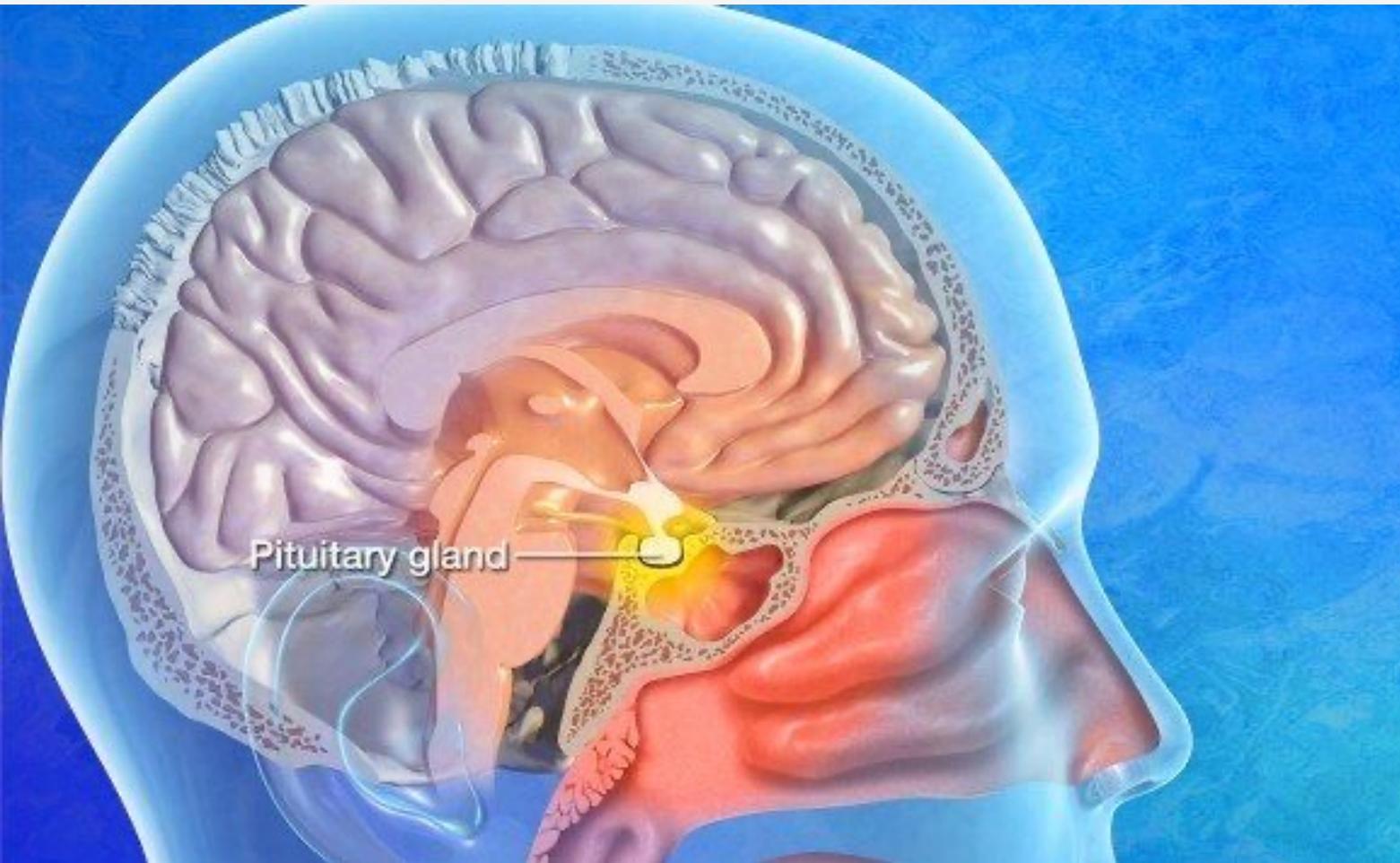
# Diabetes insipidus

- Dilute polyuria of central DI is caused by diminished or absent antidiuretic hormone (ADH) synthesis and/or release
- Causes: Direct hypothalamic injury, pituitary stalk edema, high pituitary stalk dissection
- Symptoms: polydipsia (if awake), polyuria, high serum osmolarity
- DDx: Diuresis from mannitol, hyperglycemia, excessive fluid administration
- Dx: Urine specific gravity <1.002
- Management: Increased oral intake (if awake), IV fluids (2/3 previous hour urine output plus maintenance), DDAVP 1-2 ug IV or subQ every 6-12 hours if urine output excessive





# *Your Case.....*



- 48 M
- BMI , Ht 6''7' , Wt 150kg
- DM2, HT, OSA, Migraines
- Bitemporal hemianopia, severe headaches
- s/f Endoscopic endonasal surgery



# *Take home points?*

- Investigate type of mass. Is it secretory or not? Do I need to plan for endocrine effects.
- What are the current neurological deficits?
- Look at the imaging
- Ask if neuromonitoring is involved.
- Do I need to plan for a difficult airway
- Quick finish with smooth emergence avoiding PPV.

# References

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- Cottrell & Patel Ch19. (In Press) 2023.
- Pituitary Gland Anatomy. A Foulad, N Bhandakar and A Meyers. July 29<sup>th</sup> 2015. Emedicine. <https://emedicine.medscape.com/article/1899167-overview?form=fpf>
- Goldshlager et al. 2020. Tension pneumocephalus from positive pressure ventilation following endoscopic skull base surgery: A case series and an institutional protocol for the management of postoperative respiratory distress. World Neurosurgery Volume 141 Sept 2020 p357-362
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- <https://www.uclahealth.org/medical-services/neurosurgery/pituitary-skull-base-tumor/conditions/pituitary-adenomas/acromegaly>